# HEAVY-DUTY NATURAL GAS HYBRID DRIVETRAINS

**Mike Bogdanoff**

**South Coast Air Quality Management District**

**January 29, 2003**

# Goals for HD Hybrid Technology

- **Compliance with 0.2 g/bhp-hr NOx**
- **Or even lower duty-cycle emissions!**
- **Electric-only operation**
- **Quieter operation**
- **Reduced fuel consumption**
- **Reduced maintenance costs (brakes)**

# Impediments for HD Hybrid Technology

- **Cost - Capital**
- **Cost - New technology**
- **Cost - CNG/LNG**
- **Cost - Retraining, delayed repairs**
- **Weight vs. Passenger Capacity**

# Types of HD Hybrid Technology

- **Hybrid Electric**
  - **Series – APU (smaller engine)**
    **Electric drivetrain**
    **Electric energy storage**
  - **Parallel - Smaller engine**
    **Special transmission**
    **Electric drive/assist**
    **Smaller energy storage**
- **Mechanical Hybrid (parallel)**
  - **Hydraulic**

# “Available” HD Hybrid Drivetrains

- **Siemens (series)**
- **Allison (parallel)**
- **Visteon (mechanical, light-duty)**
- **Permo-Drive (mechanical)**
- **Other DOD contractors**
- **others**

# Natural Gas Hybrid Bus Manufacturers

- **Advanced Vehicle Systems (AVS)**
  - **22- & 30-foot with Microturbines**
- **North American Bus Industries (NABI)**
  - **30-foot composite with Ford 2.5 L engine**
  - **proposed: 45-foot composite with**
    - **DDC 50G or Cummins C8.3G**
    - **Siemens or Allison drivetrain**
    - **Heavy-duty battery system**
    - **Zero-emission range TBD miles**
- **Others**

# Natural Gas Hybrid Interested Bus Manufacturers

- **Orion**
- **IRISBUS**
- **Ivahoe**
- **New Flyer**
- **Neoplan**
- **Others**

# Natural Gas Hybrid Development Needs

- **Technical study of current NG options**
- **Technology Demonstrations**
  - **Lightweight composite buses**
  - **Mechanical hybrids in transit ops**
  - **Lowest-cost hybrid electric systems**
  - **HCNG options (low emissions)**

# SCAQMD Clean Fuels Program Technology Advancement

## SCAQMD Program Information

## www.aqmd.gov

- Mike Bogdanoff, SCAQMD
  (909) 396-3254 mbogdanoff@aqmd.gov
- Naveen Berry, SCAQMD (buses)
  (909) 396-2363 nberry@aqmd.gov